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Science Advisory Report 2018/047

Quebec Region

ASSESSMENT OF THE ESTUARY AND NORTHERN GULF OF ST. LAWRENCE (AREAS 13 TO 17, 12A, 12B, 12C AND 16A) SNOW CRAB STOCKS IN 2017

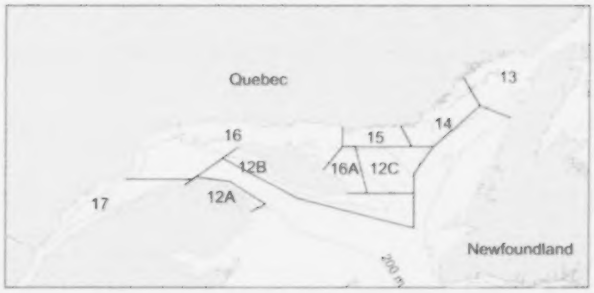

Figure 1: Snow crab management areas in the Estuary and the northern Gulf of St. Lawrence.

Context:

The snow crab fishery in the Estuary and the northern Gulf of St. Lawrence began in the late 1960s. The fishery experienced a boom from 1979 to 1985, and a management approach based on the TAC (total allowable catch) was gradually introduced between 1985 and 1995. There are nine management areas (13 to 17, 16A, 12A, 12B and 12C) (Figure 1).

Landings have varied depending on the adjusted TACs based on recruitment waves and troughs that affect the quantity of crabs available to the fishery (Figure 2), with maximum levels recorded in 1995 (7,879 t) and 2002 (10,372 t). Landings dropped considerably in 2003 owing to the lower TACs established in response to signs of overfishing, mainly in Area 16. Landings totalled 8,350.5 t in 2017.

The fishery targets only males with a carapace width ≥ 95 mm. White crab (crab that has recently moulted) and adolescent males may be returned to the water during the fishing season to enhance their meat yield and give them a chance to reproduce. Furthermore, since 1985, when the proportion of white crab in catches at sea exceeds 20%, the fishery is automatically closed in the affected area. This measure aims to minimize the mortality of these very fragile crabs, which will be available to the fishery the following year.

The DFO Fisheries and Aquaculture Management Branch, Quebec Region, requested a stock status assessment and a science advisory report to set the 2018 quotas. A scientific peer review was conducted on February 13 and 14, 2018. Participants included representatives from DFO Science and Fisheries and Aquaculture Management, the fishing industry and First Nations.

SUMMARY

- With the exception of the St. Lawrence Estuary (Area 17), all stocks in the northern Gulf of St. Lawrence (areas 13, 14, 15, 16, 16A, 12A, 12B and 12C) had a decreased commercial biomass in 2017 compared to 2016. Recruitment to the fishery decreased in 2017, except in areas 16 and 12A, suggesting a decrease in the biomass available to the fishery in 2018 in the northern Gulf. The commercial biomass in the Estuary (Area 17) increased as a result of a recruitment to the fishery that was still high in 2017. However, a decrease in the abundance of adolescents less than 78 mm suggests a decline in recruitment in two or more years. The commercial biomass decreased in areas 12A and 12B, and recruitment during the next few years could depend on productivity in adjacent areas.
- The purpose of conservation is to maintain an adequate male reproductive biomass in order to ensure the recovery or maintenance of the population in a given area. Recommendations assume that the natural mortality rate will be the same in 2018 as in previous years.

Outlook

Area 17

- The rise in the combined index and the high values of the scientific survey suggest a potential increase in catches in 2018 compared to 2017:

1) A 25% increase in catches could lead to a high harvesting intensity and a stabilization of the biomass available to the fishery in 2019.
2) An increase of approximately 15% in catches should lead to a moderate harvesting intensity and help increase the biomass available to the fishery in 2019.
3) An increase in catches below 10% would help maintain the biomass available to the fishery over a longer period.

Area 16

- The commercial fishery and post-season survey indicators are stable, but the scientific surveys suggest a decline in recruitment over the next few years:

1) An unchanged TAC could lead to a decrease in the biomass if recruitment decreases as the post-season survey suggests.
2) A 10% decrease could help maintain the biomass available to the fishery.
3) A greater decrease would help maintain the biomass available to the fishery over a longer period.

Area 15

- The combined index suggests that the biomass available to the fishery will be slightly lower in 2018 than in 2017:

1) An increase of 10% could lead to a high harvesting intensity and decrease the biomass.
4) The status quo should maintain the biomass or limit the decline if recruitment is low.
5) A 10% decrease could maintain a higher residual biomass.

Area 14

- The drop in the combined index suggests that 2018 catches should decrease compared to 2017:

1) A decrease of 10% would lead to a high harvesting intensity.

6) A decrease of approximately 20% would be unlikely to lead to an excessively high harvesting intensity and would moderate the effect of expected low recruitment.

7) A decrease of more than 20% could help maintain a substantial biomass available to the fishery over a longer period of time.

Area 13

- This stock was reopened to fishing in 2008, following a moratorium from 2003 to 2007, and the TAC is still at a historically low and cautious level. Constraints on the spatial distribution of the commercial fishing effort may have negatively affected the CPUE:

1) The status quo would lead to a high harvesting intensity and increase the effect of expected low recruitment.

8) A decrease of approximately 10% would be unlikely to lead to an excessively high harvesting intensity and would moderate the effect of expected low recruitment.

9) A decrease of 20% or more could help maintain a substantial biomass available to the fishery over a longer period of time.

Area 16A

- The drop in the combined index suggests that 2018 catches should decrease compared to 2017, although the CPUE could underestimate the stock status because of the presence of ice:

1) The status quo could lead to a high harvesting intensity and cause a decrease in the biomass if the CPUE has not been underestimated.

2) A 10% decrease could stabilize the biomass available to the fishery.

10) A greater decrease would maintain a higher biomass over a longer period.

Area 12C

- The drop in the combined index suggests that 2018 catches should decrease compared to 2017:

1) A decrease of 10% or less would lead to a high harvesting intensity and a decrease in the commercial biomass.

11) A 20% decrease would be unlikely to lead to an excessively high harvesting intensity and would mitigate the decrease in the commercial biomass.

12) A decrease of more than 20% could help maintain the biomass available to the fishery over a longer period of time.

Area 12B

- The fact that the TAC was not reached, the sharp decline in the catch rate, and the decline in crab size suggest that stock status continues to deteriorate. Because of the limited amount of data and the high degree of uncertainty regarding the status of the biomass for this area, it is impossible to make specific recommendations.

- It is recommended to set the harvest level at the lowest possible level that can allow monitoring of the area, following consultation between industry and fisheries management.

Area 12A

- Indicators of biomass available to the fishery remain low for 2018, but the post-season survey suggests increased recruitment.

1) An increase in catches of up to 10% could result in biomass levels decreasing or staying the same depending on the recruitment level next year.

13) A status quo in catches would help maintain the biomass in the absence of recruitment.

14) A decrease in catches of more than 10% could help maintain or increase the biomass available to the fishery.

INTRODUCTION

Species biology

In Canada, snow crab can be found from the southern tip of Nova Scotia to halfway up the Labrador coast, as well as in the Estuary and Gulf of St. Lawrence. In the Gulf of St. Lawrence, commercial-size males live at depths ranging from 50 m to 200 m, except during their winter moulting and reproductive periods, during which they migrate to shallower waters. Snow crab stop growing after the terminal moult. Males are considered subadults or adolescents (small claws) prior to the terminal moult and adults (large claws) afterwards. Male carapace width (CW) ranges from 40 mm to 165 mm after the terminal moult. If they do not undergo their terminal moult earlier, males reach legal size (95 mm CW) at about 9 years of age. The proportion of males that reach the legal size is correlated with the temperature of the environment throughout their development. Snow crab recruitment is periodic or episodic and varies considerably over an 8- to 12-year cycle. The entry of recruits into the fishery can be determined by regular monitoring of landings (carapace size and condition) and the catch rate (catch per unit effort or CPUE), and is confirmed by scientific trap and trawl surveys. Global warming and specifically recent years' upward trend in the average temperature of the deep layer could affect snow crab distribution and productivity by warming and thinning the cold intermediate water layer, its habitat.

RESOURCE ASSESSMENT

Analyses of all areas are based on fishing data from logbooks, processing plant purchase slips and dockside weighing summaries, along with catch sampling data obtained from the Observers Program and DFO samplers. In 2017, the industry conducted a trap-based research survey in all fishing areas (except in Area 12B, where there was no survey, and Area 13, where two independent surveys (northern and southern) were conducted), and the findings were incorporated into the stock status assessments. These surveys help determine the average NUE (numbers per unit effort) of legal-size crab by area and the NUE of adolescent crab with a carapace more than 78 mm wide that will reach or exceed legal size during the next moult. The results of the trawl research surveys conducted in 2016 and 2017 in areas 13 and 17 were used to calculate a juvenile or adult crab abundance index.

The fishery's raw catches per unit effort (CPUE) were standardized using an additive model to account for seasonal changes, gear type, soak time and fishing site. The proportion of recruits (or new crab), which can be identified by its new carapace (carapace conditions 1 and 2), was determined by dockside samplers.

Since 2013, a combined index was introduced to obtain a better estimate of the short-term commercial biomass trend and help increase the consistency of the inter-annual recommendations for a given stock. This index is based on two biomass indices: the post-season NUE for adult males ≥ 95 mm (the average NUE from the north and south surveys in Area 13) and the standardized commercial CPUE. The combined index is calculated by standardizing each of the two indices according to their respective average and standard deviation over the 2000 to 2012 reference period and averaging them for the current year.

Data on the size structure of crab sampled at sea, dockside and during trap surveys were also used.

To date, data on female insemination levels have been collected sporadically in certain areas. Annual systematic sampling of each area is recommended so this parameter can be used for stock status assessments because it is a measure of primiparous female mating success and the relative abundance of large adult males.

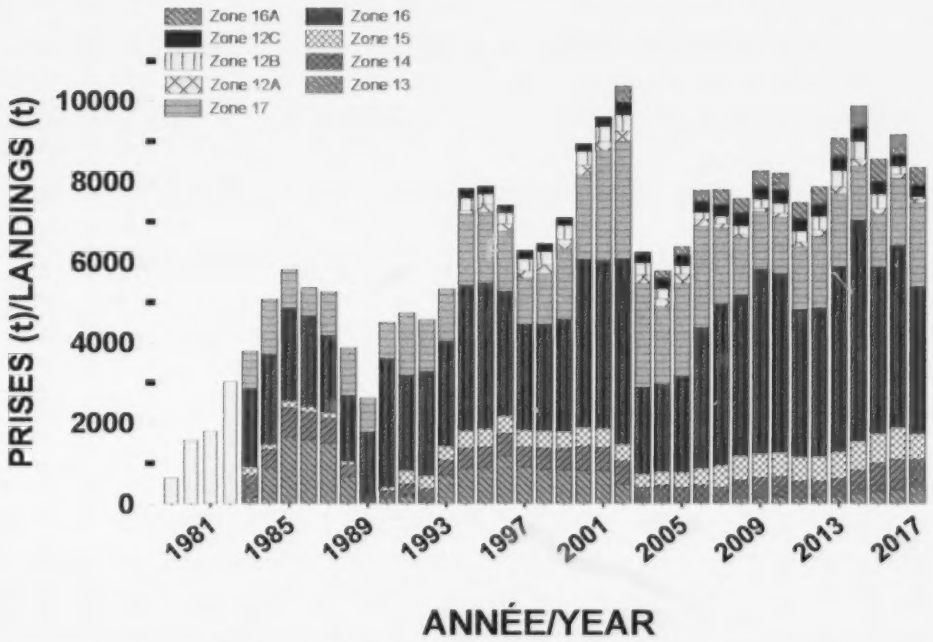

Figure 2. Snow crab landings in the Estuary and northern Gulf of St. Lawrence. From 1979 to 1982, landings were not attributed to their area of origin.

Area 17

Description of the fishery

In Area 17, 21 fishers hold regular licences in Group A (88% of the TAC) and 20 fishers hold special licences in Group B (12% of the TAC). The TAC increased by 25% between 2016 and 2017 to 2,098 t (Figure 3). The 2017 fishing season opened on March 29 and closed on June 24. The TAC was reached.

Resource status in 2017

Commercial fishery. The standardized CPUE increased very slightly in 2017 and was well above the historical average (Figure 4). Landings consisted of an equal proportion of intermediate-shell crab (carapace condition 3) and recruits (carapace conditions 1 and 2), which have been increasing since 2014. The average size of legal-size crab caught at sea, low since 2014, increased in 2017 and was below the historical average (Figure 5).

Fishery-independent surveys. The trap-based research survey, a data series that began in 1996 on the North Shore and in 1999 on the South Shore, shows that the NUE of adults ≥ 95 mm increased slightly in 2017 (Figure 6) due to a slight increase in crabs left by the fishery, and was near average. The NUE in recruits increased in 2017 and was at the historical average (Figure 7). The abundance of adolescents ≥ 78 mm was still high in the trawl scientific survey, which suggests that recruitment to the fishery could be good in 2018. However, the abundance of smaller adolescents decreased, which suggests a recruitment decline in two years or in the longer term.

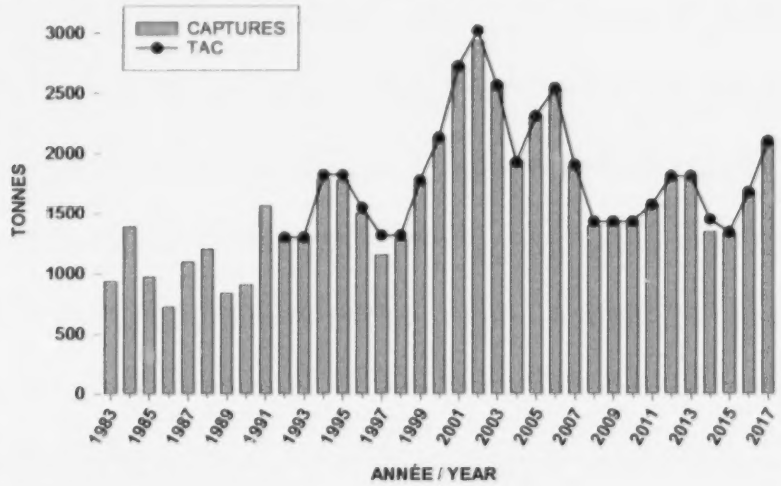

Figure 3. Annual landings and TACs in Area 17.

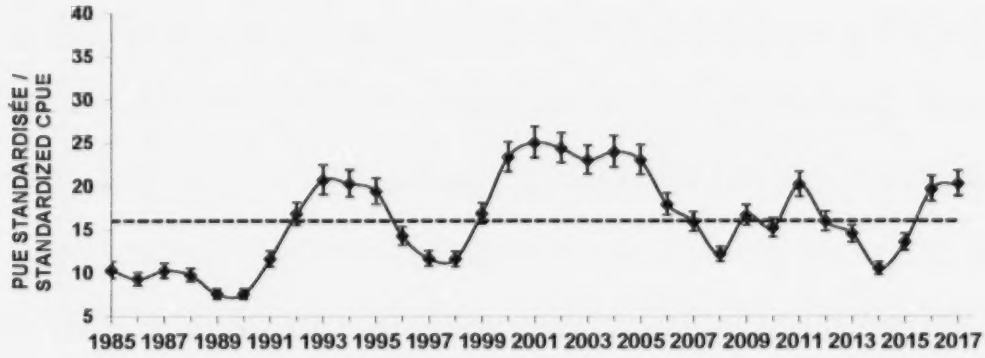

Figure 4. Standardized annual CPUE ± confidence interval in the commercial fishery in Area 17. The dotted line shows the data series average (excluding 2017).

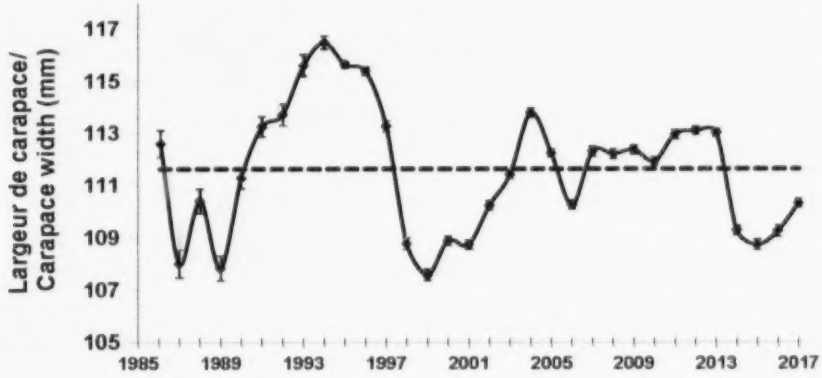

Figure 5: Carapace width ± confidence interval in the commercial fishery in Area 17. The dotted line shows the data series average (excluding 2017).

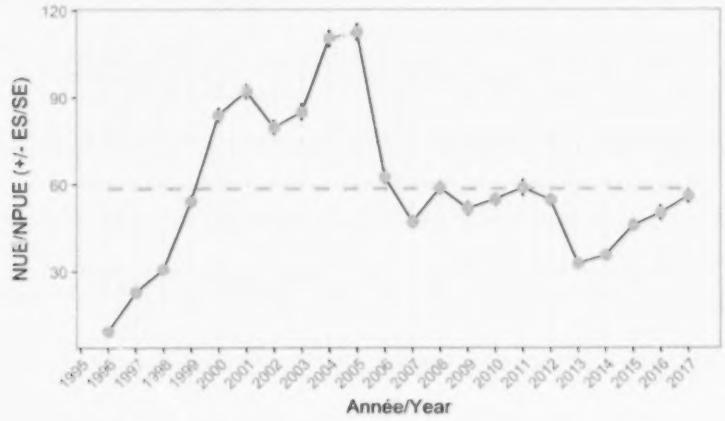

Figure 6. Annual catch rates (NUE) (± standard error) of adult crab ≥ 95 mm from the post-season survey in Area 17. The dotted line shows the data series average.

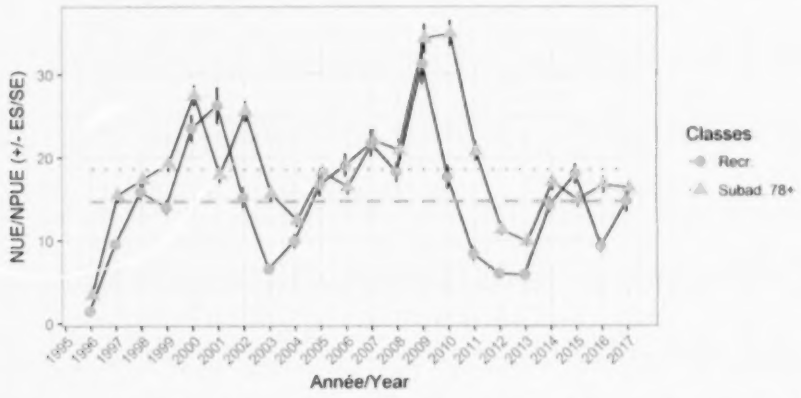

Figure 7. Annual catch rates (NUE) (± standard error) of recruits (Recruits) and adolescents (Subadults) ≥ 78 mm from the post-season survey in Area 17.

The combined index of commercial CPUE and of NUE in the post-season survey increased (+8.5%) and was above the historic high in 2017. This suggests that there will be more biomass available in the 2018 fishing season than there was in 2017.

Preferred snow crab habitat in Area 17 has decreased in recent years, which could have an impact on stock productivity.

Outlook and conclusions

The rise in the combined index and the high values of the scientific survey suggest a potential increase in catches in 2018 compared to 2017:

1) A 25% increase in catches could lead to a high harvesting intensity and a stabilization of the biomass available to the fishery in 2019.
2) An increase of approximately 15% in catches should lead to a moderate harvesting intensity and help increase the biomass available to the fishery in 2019.
3) An increase in catches below 10% would help maintain the biomass available to the fishery over a longer period.

Area 16

Description of the fishery

In Area 16, 38 fishers hold regular snow crab licences in Group A (92.7% of the TAC) and 16 fishers hold special licences in groups B and C (7.3% of the TAC). The TAC decreased by 20% in 2017, to 3,648 t (Figure 8). The 2017 fishery opened on April 8 and closed on July 14. The TAC was reached.

Resource status in 2017

Commercial fishery. After peaking from 2013 to 2015, the standardized CPUE decreased and was below the historical average in 2017 (Figure 9). Landings consisted of a significant proportion of recruits (carapace conditions 1 and 2), which had been increasing after a 2015 trough, and then reached one of the highest values observed since 2006.

Fishery-independent surveys. The trap-based research survey, conducted every fall since 1994, shows that the NUE of adults ≥ 95 mm (Figure 11) remained stable and slightly increased compared to 2016, and was slightly below average. The NUE of adolescents ≥ 78 mm also slightly increased in 2017 and reached the historical average (Figure 12). The NUE of recruits also increased and continued to be well above the historical average (Figure 12). The trawl survey results suggest lower recruitment in the short to medium term but an increase in the longer term (5 to 7 years). The average size of legal-size crab caught at sea was comparable to 2016 and was above the historical average (Figure 10).

The combined index of commercial CPUE and NUE from the post-season survey remained unchanged compared to 2016 (-0.3%), suggesting that the biomass available to the fishery in 2018 should be similar to that of 2017.

The spermathecae of primiparous females from Sainte-Marguerite Bay contained more sperm from 2015 to 2017 than in the previous six years, indicating high mating success. This higher mating success was associated with increased large-male availability in the last three years.

A marked decrease in the preferred habitat of snow crab in Area 16 has been observed in recent years, which could have an impact on stock productivity.

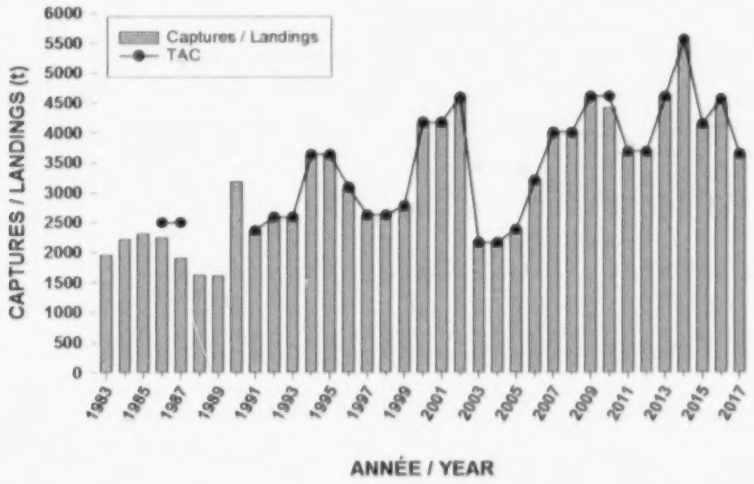

Figure 8. Annual landings and TACs in Area 16.

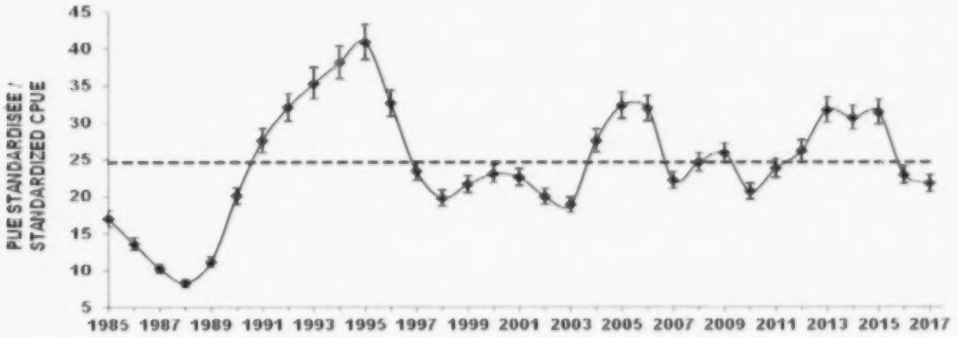

Figure 9. Standardized annual CPUE ± confidence interval in the commercial fishery in Area 16. The dotted line shows the data series average (excluding 2017).

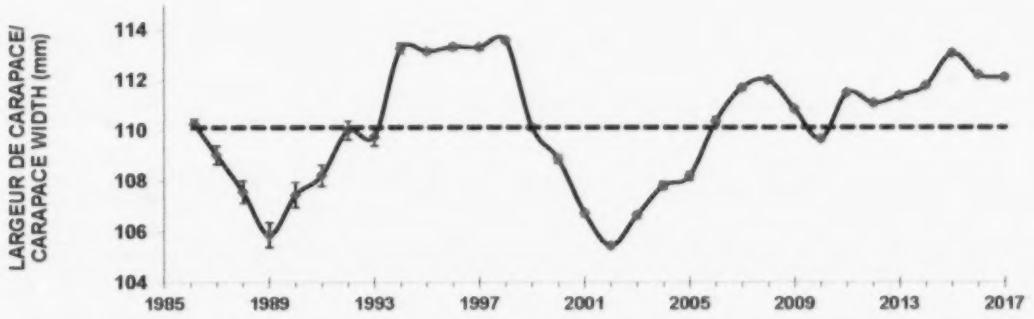

Figure 10: Carapace width ± confidence interval in the commercial fishery in Area 16. The dotted line shows the data series average (excluding 2017).

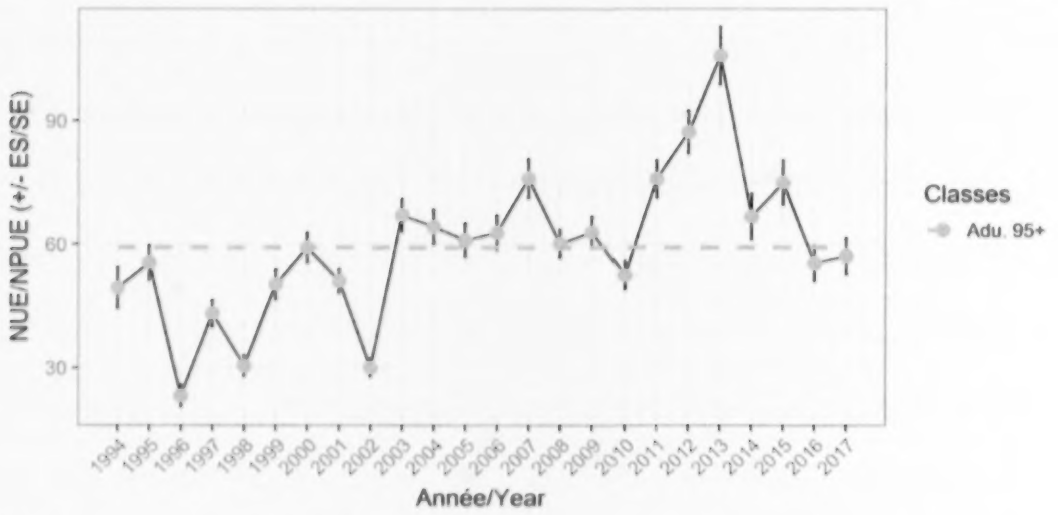

Figure 11. Annual catch rates (NUE) (± standard error) of adult crab ≥ 95 mm from the post-season survey in Area 16. The dotted line shows the data series average.

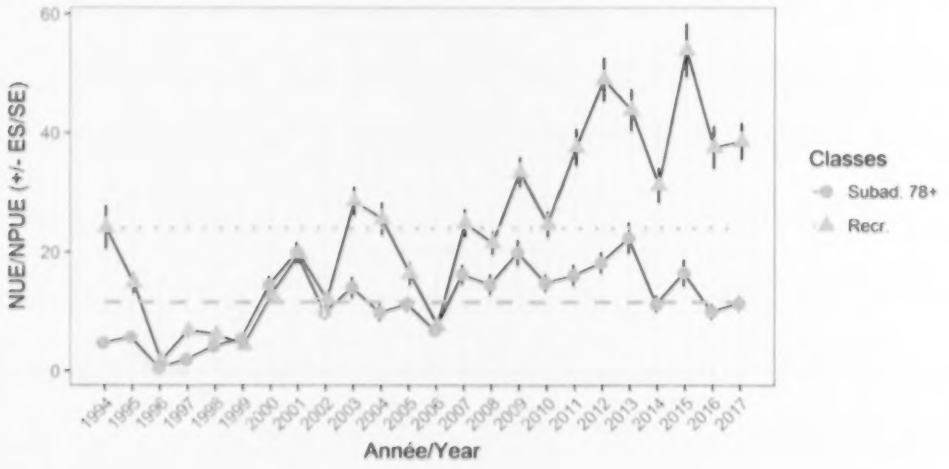

Figure 12. Annual catch rates (NUE) (± standard error) of recruits (Recruits) and adolescents (Subadults) ≥ 78 mm from the post-season survey in Area 16.

Outlook and conclusions

The commercial fishery and post-season survey indicators are stable, but the scientific surveys suggest a decline in recruitment over the next few years:

1) An unchanged TAC could lead to a decrease in the biomass if recruitment decreases as the post-season survey suggests.
2) A 10% decrease could help maintain the biomass available to the fishery.
3) A greater decrease would help maintain the biomass available to the fishery over a longer period.

Area 15

Description of the fishery

In Area 15, 8 fishers hold regular licences in Group A (90.7% of the TAC) and 24 fishers hold special licences in Group B (9.3% of the TAC). The TAC decreased by 20% between 2015 and 2016, to 632 t (Figure 13), and was reached. In 2017, the fishery was allowed within two optional periods: either from April 10 to July 16 or from April 17 to July 23.

Resource status in 2017

Commercial fishery. The standardized CPUE decreased in 2017 compared to 2016 but remained above the historical average (Figure 15). Landings in 2017 consisted primarily of recruits, after a decrease from 2013 to 2016, followed by intermediate-shell crab (carapace condition 3), whose proportion decreased from 2016 to 2017. The average size of legal-size crab caught at sea has been decreasing since 2016 and was above the historical average (Figure 14).

Fishery-independent survey. The protocol for trap-based research was changed in 2014 to allow the use of larger, standard conical traps of 6.5 ft. Both types of traps, former and new, were being used from 2014 to 2016, whereas the new type was used only in 2017. Since catchability with this type of trap needs to be evaluated in comparison with the former traps, only the data including this new type of trap are presented in 2017. The trap-based research survey shows a below-average decrease in the NUE of adults ≥ 95 mm (Figure 16). The NUE of adolescent crab ≥ 78 mm and recruits decreased to below average, suggesting higher recruitment in the short and medium term (Figure 17).

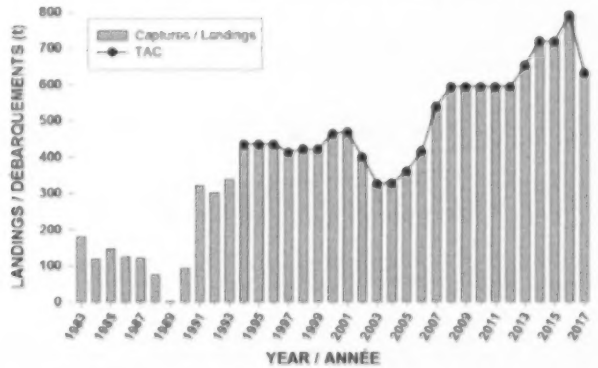

Figure 13. Annual landings and TACs in Area 15.

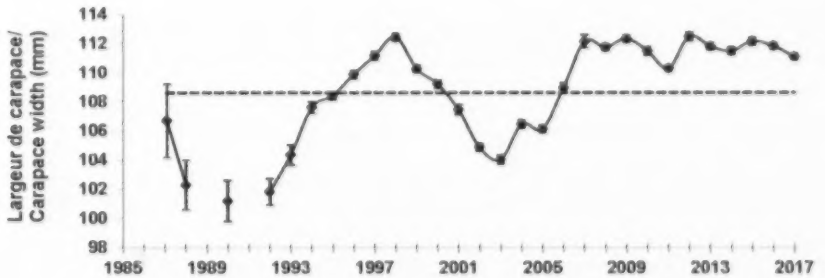

Figure 14: Carapace width ± confidence interval in the commercial fishery in Area 15. The dotted line shows the data series average (excluding 2017).

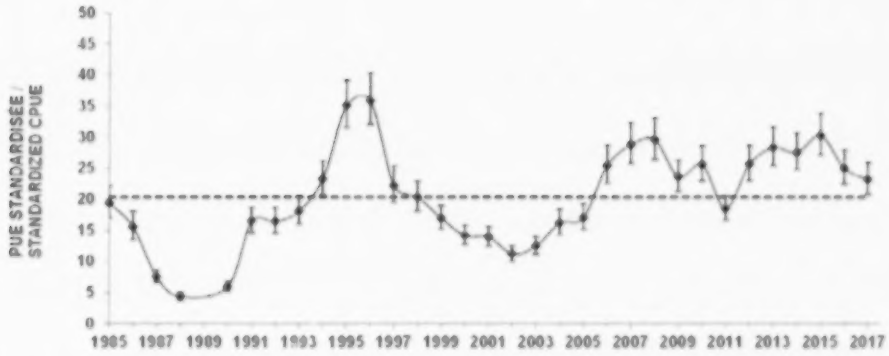

Figure 15. Standardized annual CPUE ± confidence interval in the commercial fishery in Area 15. The dotted line shows the data series average (excluding 2017).

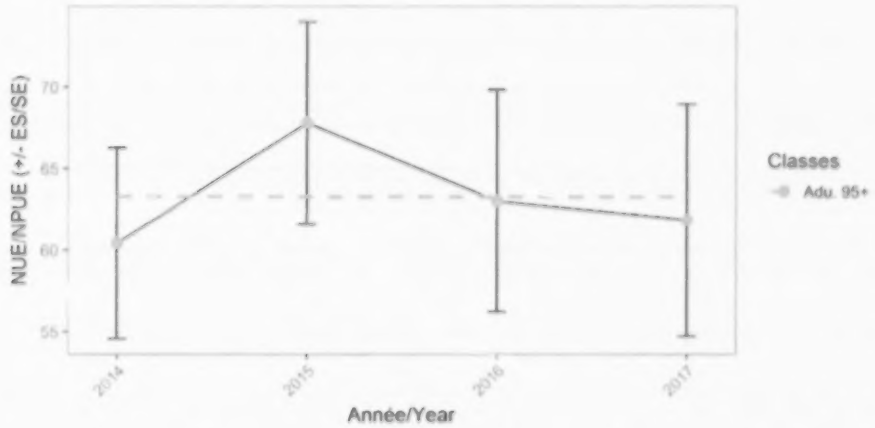

Figure 16. Annual catch rates (NUE) (± standard error) of adult crab ≥ 95 mm from the post-season survey in Area 15. The dotted line shows the data series average.

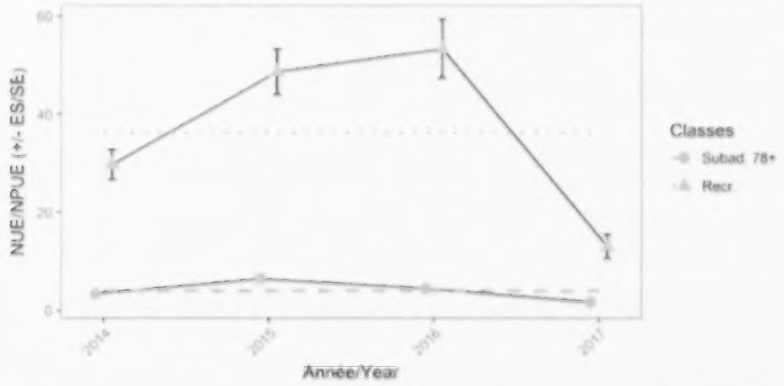

Figure 17. Annual catch rates (NUE) (± standard error) of recruits (Recruits) and adolescents (Subadults) ≥ 78 mm from the post-season survey in Area 15.

The combined index of the commercial CPUE and the post-season survey number per unit effort (NUE) decreased by 5%, suggesting that the biomass available to the fishery will be lower in 2018 than in 2017.

Outlook and conclusions

The combined index suggests that the biomass available to the fishery will be slightly lower in 2018 than in 2017:

1) An increase of 10% could lead to a high harvesting intensity and decrease the biomass.
2) The status quo should maintain the biomass or limit the decline if recruitment is low.
3) A 10% decrease could maintain a higher residual biomass.

Area 14

Description of the fishery

Area 14 has 21 regular licences. Since 2016, the TAC decreased by 10%, to 686 t in 2017 (Figure 18). In 2017, the fishery was allowed within two optional periods: either from May 7 to August 12 or from May 15 to August 20. The TAC was reached.

Resource status in 2017

Commercial fishery. After reaching its highest value in the last year of the period 1985 to 2016, the standardized CPUE decreased sharply in 2016 but was still well above the historical average (Figure 19). Recruits (carapace conditions 1 and 2), whose proportion increased in landings from 2008 to 2013, subsequently decreased. As a result, the proportion of intermediate-shell crab (carapace condition 3) has been increasing since 2015. The average size of legal-size crab caught at sea has been decreasing since 2013 and was above the historical average (Figure 20).

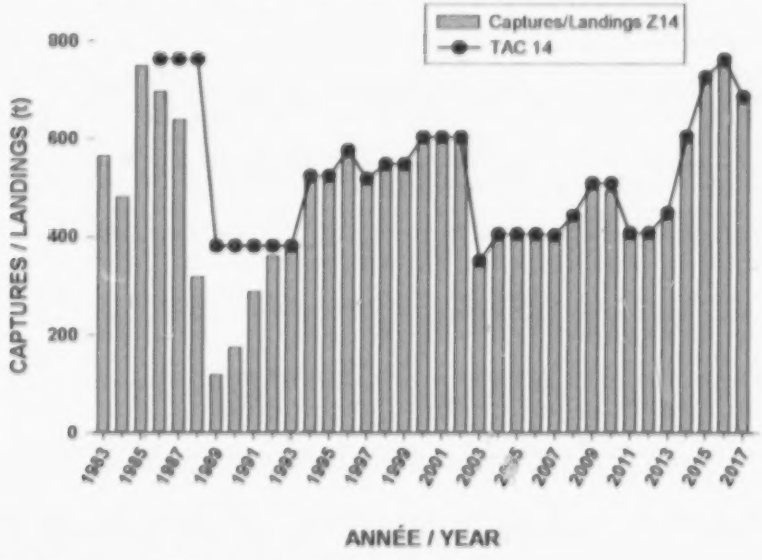

Figure 18. Annual landings and TACs in Area 14.

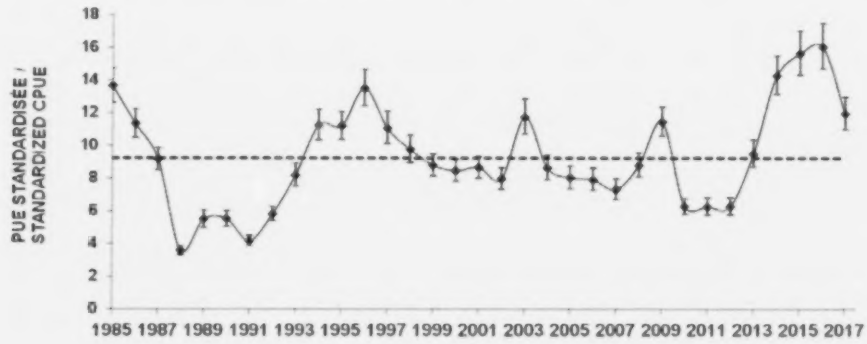

Figure 19. Standardized annual CPUE ± confidence interval in the commercial fishery in Area 14. The dotted line shows the data series average (excluding 2017).

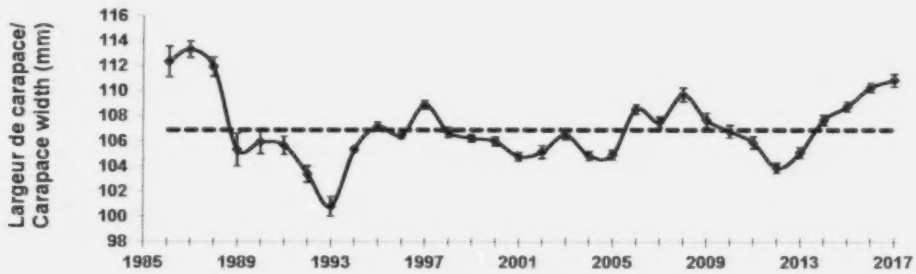

Figure 20: Carapace width ± confidence interval in the commercial fishery in Area 14. The dotted line shows the data series average (excluding 2017).

Fishery-independent survey. The trap-based research survey, conducted since 1996, shows that the NUE of adults ≥ 95 mm (Figure 21) and of recruits (Figure 22) decreased sharply from 2014 to 2017. They were, respectively, slightly below and above their historical average in 2017. The NUE of adolescents ≥ 78 mm has been decreasing since 2013 and was low (Figure 22), suggesting a decrease in recruitment in the short to medium term.

The combined index of commercial CPUE and NUE in the post-season survey decreased (-33%) for a third consecutive year. This indicator suggests that the biomass available to the fishery will be lower in 2018 than in 2017.

In 2017, the exceptional presence of ice during the fishing season was reported, and may have caused a reduction of the CPUE for 2017.

Outlook and conclusions

The drop in the combined index suggests that 2018 catches should decrease compared to 2017:

1) A decrease of 10% would lead to a high harvesting intensity.
2) A decrease of approximately 20% would be unlikely to lead to an excessively high harvesting intensity and would moderate the effect of expected low recruitment.

3) A decrease of more than 20% could help maintain a substantial biomass available to the fishery over a longer period of time.

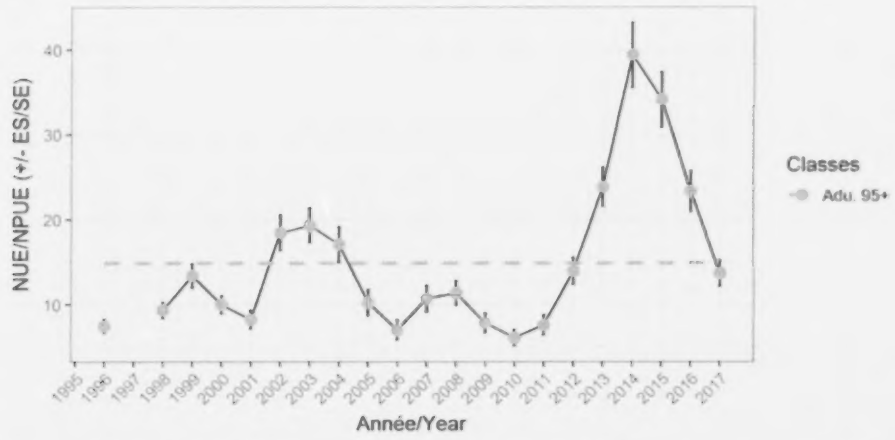

Figure 21. Annual catch rates (NUE) (± standard error) of adult crab ≥ 95 mm from the post-season survey in Area 14. The dotted line shows the data series average.

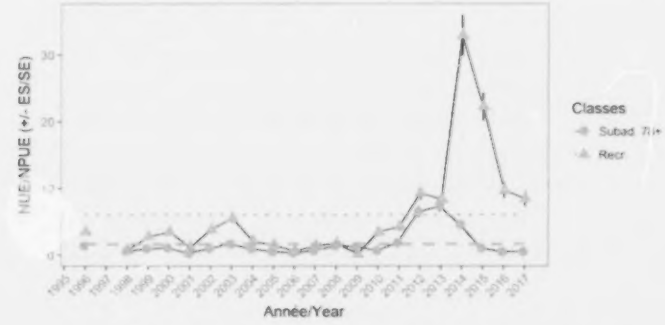

Figure 22. Annual catch rates (NUE) (± standard error) of recruits (Recruits) and adolescents (Subadults) ≥ 78 mm from the post-season survey in Area 14.

Area 13

Description of the fishery

Area 13 has 43 regular fishers from Quebec and 6 from Newfoundland. The area was placed under a moratorium from 2003 to 2007 as a result of a marked decline in the biomass of legal-size crab. However, an index fishery with an annual TAC of 50 t was approved in 2003, 2004 and 2006. When the area was reopened in 2008, it was decided that precautionary, meaning low, TACs would be in effect at first and would gradually increase only if the stock indices remained positive despite harvesting. The TAC increased by 20% to 406 t between 2016 and 2017 (Figure 23) and was reached. In 2017, the fishery was allowed within two optional periods: either from May 8 to August 13 or from May 15 to August 20.

Resource status in 2017

Commercial fishery. The standardized CPUE decreased in 2017 compared to 2016 and 2015 but was well above the historical average (Figure 24). Recruits (carapace conditions 1 and 2), whose numbers were increasing in landings from 2010 to 2015, decreased in 2016 and 2017, whereas landings consisted primarily of intermediate-shell crab (carapace condition 3). From 2009 to 2014, the fishing effort was significantly higher in the southern part than the northern part. In 2015 and 2016, the fishing effort was divided almost equally between both parts. In 2017, however, it was higher in the northern part. The average size of legal-size crab caught at sea decreased in 2017 and was slightly above average (Figure 25). This average size remained stable over the preceding 10 years but was low (104.7 mm) compared with other areas in the northern Gulf of St. Lawrence.

Fishery-independent surveys. The trap-based research surveys conducted since 1999 show that in 2016, as compared with 2015, the NUE of adults ≥ 95 mm in the northern part decreased to a value that was still well above average (Figure 26); in the southern part, it decreased sharply to the lowest value since the start of the 1999 survey (Figure 27). In 2017, the NUE of recruits in the northern part decreased to slightly above average after reaching the highest value of the series in 2016 (Figure 28). However, it decreased to near-zero in the southern part (Figure 29).

In the northern part, the post-season survey shows an increase in the abundance of adolescents ≥ 78 mm in the last two years (Figure 28), whereas the trawl survey shows a decrease. The post-season survey conducted in the southern part also shows a low abundance of adolescents ≥ 78 mm (Figure 29).

The combined index of commercial CPUE and NUE from the post-season surveys decreased by 42% but was still above the reference period average (2000 to 2012). This result suggests a decrease in the available biomass in 2018 compared with 2017.

Commercial fishing performance is consistent with the results of the 2016 trawl scientific survey conducted in Area 13, which forecasts a decline in recruitment for a few years. This survey also shows, for 2016, a very high abundance of crab less than 35 mm that should start recruiting to the fishery as of the early 2020s.

In 2017, the exceptional presence of ice during the fishing season was reported, and may have caused a reduction of the CPUE for 2017.

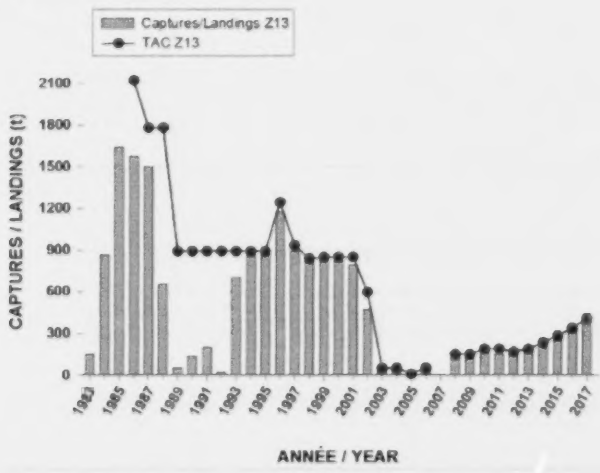

Figure 23. Annual landings and TACs in Area 13.

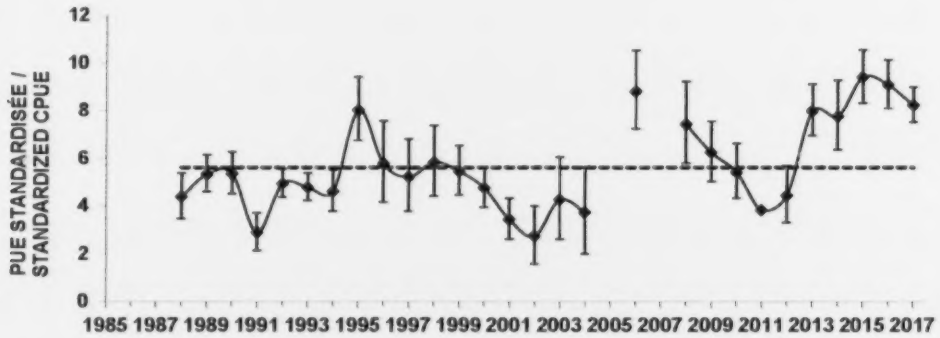

Figure 24. Standardized annual CPUE ± confidence interval in the commercial fishery in Area 13. The dotted line shows the data series average (excluding 2017).

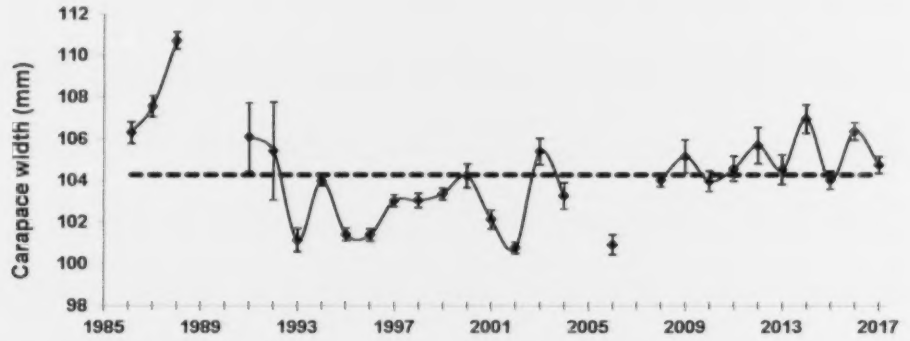

Figure 25: Carapace width ± confidence interval in the commercial fishery in Area 13. The dotted line shows the data series average (excluding 2017).

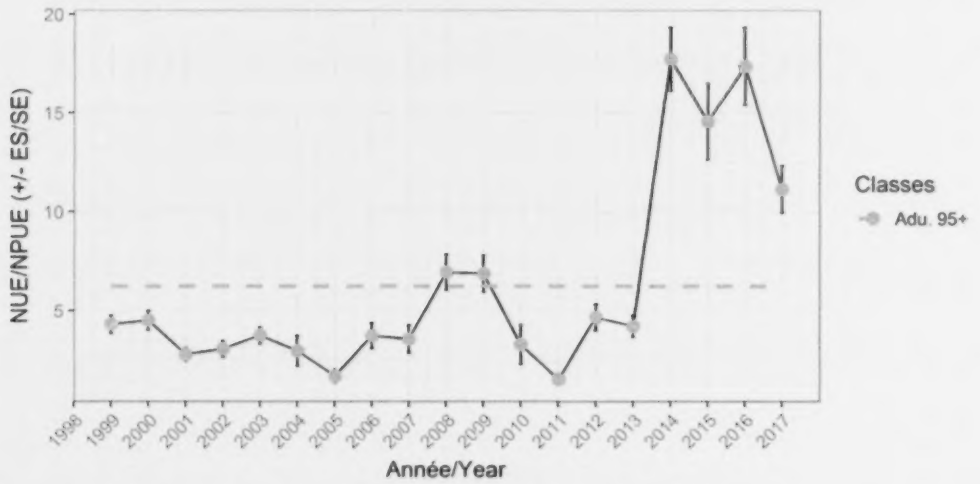

Figure 26. Annual catch rates (NUE) (± standard error) of adult crab ≥ 95 mm from the post-season survey in northern Area 13. The dotted line shows the data series average.

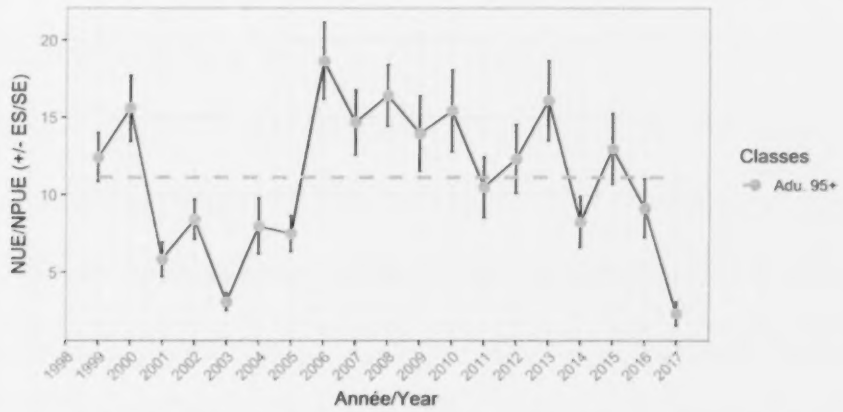

Figure 27. Annual catch rates (NUE) (± standard error) of adult crab ≥ 95 mm from the post-season survey in southern Area 13. The dotted line shows the data series average.

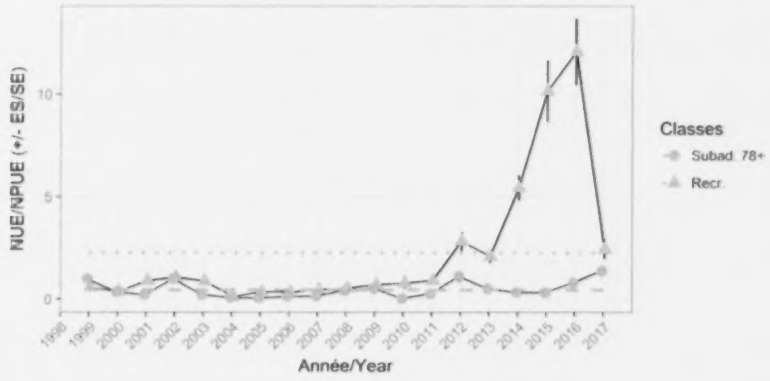

Figure 28. Annual catch rates (NUE) (± standard error) of recruits (Recruits) and adolescents (Subadults) ≥ 78 mm from the post-season survey in northern Area 13.

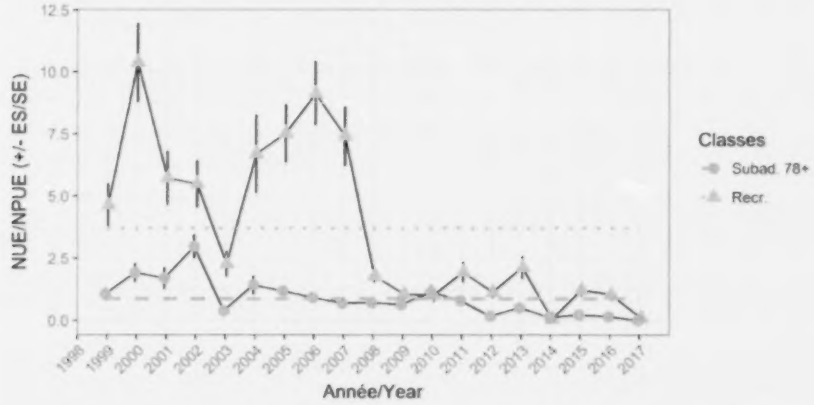

Figure 29. Annual catch rates (NUE) (± standard error) of recruits (Recruits) and adolescents (Subadults) ≥ 78 mm from the post-season survey in southern Area 13.

The combined index of commercial CPUE and average NUE from the post-season surveys decreased by 42% but was still above the reference period average (2000 to 2012). This result suggests a decrease in the available biomass in 2018 as compared with 2017.

Outlook and conclusions

This stock was reopened to fishing in 2008, following a moratorium from 2003 to 2007, and the TAC is still at a historically low and cautious level.

Constraints on the spatial distribution of the commercial fishing effort may have negatively affected the CPUE:

1) The status quo would lead to a high harvesting intensity and increase the effect of expected low recruitment.
2) A decrease of approximately 10% would be unlikely to lead to an excessively high harvesting intensity and would moderate the effect of expected low recruitment.
3) A decrease of 20% or more could help maintain a substantial biomass available to the fishery over a longer period of time.

Area 16A

Description of the fishery

Area 16A includes two parts (north and south) separated by the Anticosti Channel. Since 2002, it has been accessible to the 43 Quebec fishers holding a snow crab fishing licence in Area 13. The TAC peaked at 566 t in 2015, then it decreased by 10% in 2016 and 2017 to 458.7 t (Figure 30). In 2017, the fishery was allowed within two optional periods: either from April 9 to July 15 or from April 17 to July 23. The TAC was reached.

Resource status in 2017

Commercial fishery. The standardized CPUE increased from 2011 to 2014 and then decreased as of 2015. In 2017, it reached the lowest value since the beginning of this series (Figure 31). Recruits (carapace conditions 1 and 2) increased in landings from 2011 to 2013, then decreased at a comparable proportion between 2016 and 2017. If landings were still dominated by intermediate-shell crab (carapace condition 3), the proportion of old-shelled crab (4 and 5) progressed to a point higher than that of the recruits. The average size of legal-size crab caught at sea has been decreasing since 2016 and was slightly above the historical average (Figure 32).

Fishery-independent survey. The protocol for trap-based research was changed in 2014 to require the exclusive use of larger, standard conical traps of 6.5 ft. Both types of traps, former and new, were being used from 2014 to 2016, whereas the new type was used only in 2017. Since catchability with this type of trap needs to be evaluated in comparison with the former traps, only the data including this new type of trap are presented in 2017. The trap-based research survey shows that, after declining for two consecutive years, the NUE of adults ≥ 95 mm increased in 2017, but remained low (Figure 33)). The NUE of adolescents ≥ 78 mm has been gradually increasing since 2014, whereas that of the recruits continued to decrease over that same period (Figure 34)).

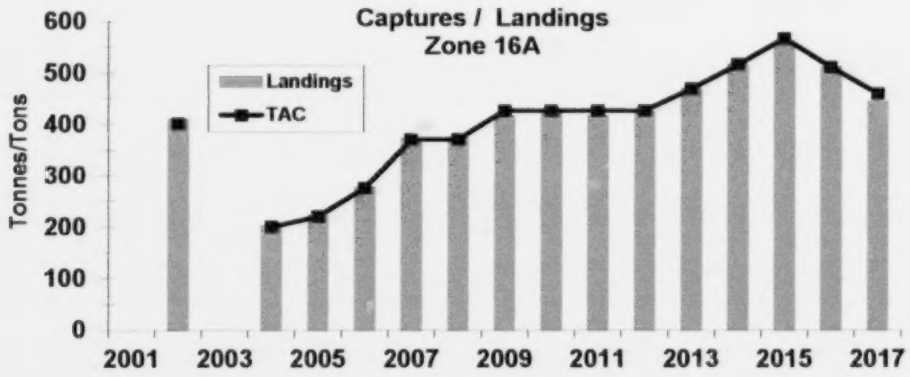

Figure 30. Annual landings and TACs in Area 16A.

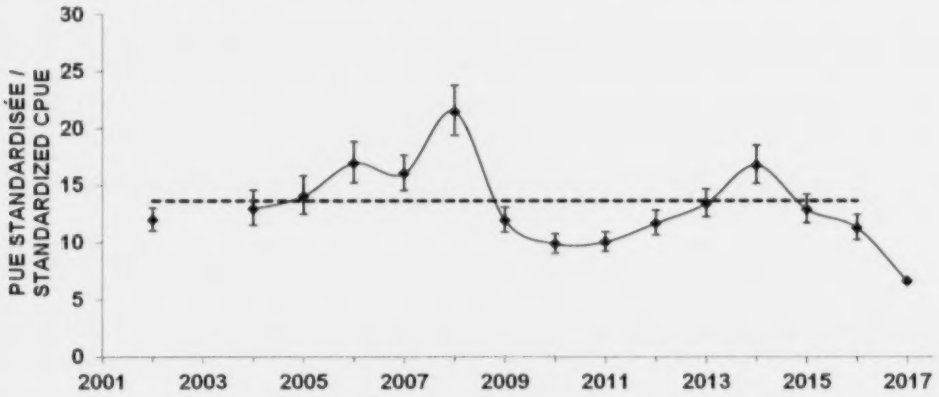

Figure 31. Standardized annual CPUE ± confidence interval in the commercial fishery in Area 16A. The dotted line shows the data series average (excluding 2017).

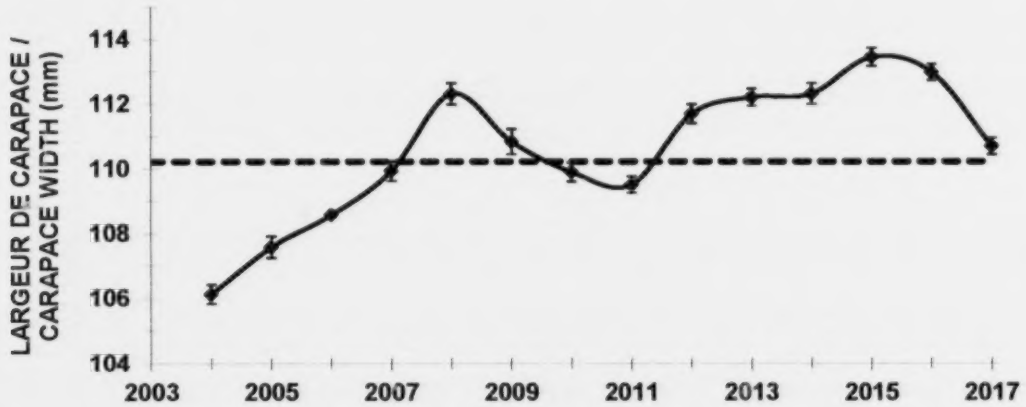

Figure 32: Carapace width ± confidence interval in the commercial fishery in Area 16A. The dotted line shows the data series average (excluding 2017).

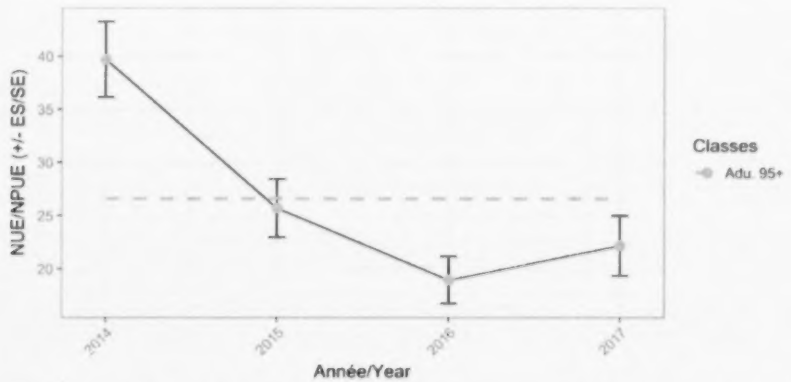

Figure 33. Annual catch rates (NUE) (± standard error) of adult crab ≥ 95 mm from the post-season survey in Area 16A. The dotted line shows the data series average.

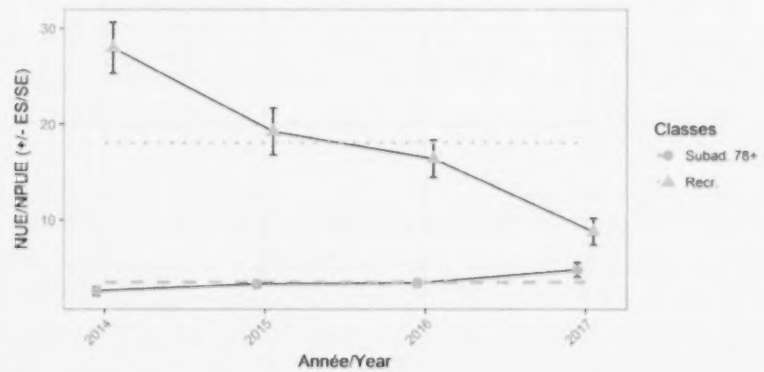

Figure 34. Annual catch rates (NUE) (± standard error) of recruits (Recruits) and adolescents (Subadults) ≥ 78 mm from the post-season survey in Area 16A.

The combined index of commercial CPUE and NUE from the post-season survey has been decreasing since 2014, and the value was 15% lower in 2017 than in 2016; this suggests that the commercial biomass available to the fishery will be lower in 2018 than in 2017.

Preferred snow crab habitat in Area 16A has decreased in recent years, which could have an impact on stock productivity.

In 2017, the exceptional presence of ice during the fishing season was reported, and may have caused a reduction of the CPUE in 2017.

Outlook and conclusions

The drop in the combined index suggests that 2018 catches should decrease compared to 2017, although the CPUE could underestimate the stock status because of the presence of ice:

1) The status quo could lead to a high harvesting intensity and cause a decrease in the biomass if the CPUE has not been underestimated.
2) A 10% decrease could stabilize the biomass available to the fishery.
3) A greater decrease would maintain a higher biomass over a longer period.

Area 12C

Description of the fishery

Area 12C includes two parts (north and south) separated by the deep Anticosti Channel. Area 12C has 5 regular licences in Group A (68.7% of the TAC) and 38 special licences in Group B (31.3% of the TAC). The TAC peaked at 352 t in 2014, then it decreased by 10% in 2015 and 2016 to 285 t, and was maintained at this value in 2017 (Figure 35). In 2017, Group A fishers could choose between two optional opening and closing periods: from April 17 to July 23 or April 24 to July 30. Group B was restricted to April 24 to July 30.

Resource status in 2017

Commercial fishery. In 2017, the standardized CPUE decreased slightly below the historical average (Figure 36). The fishing effort was concentrated mainly in the northern part of the area. Recruits (carapace conditions 1 and 2), whose numbers increased in landings from 2011 to 2013, then gradually decreased in number, and constituted a comparable proportion in 2016 and 2017 that was significantly lower than the proportion of intermediate-shell crab (carapace condition 3). The proportion of old-shelled crab (conditions 4 and 5) remained lower in 2017 than that of intermediate-shell crab, but it progressed significantly closer to the proportion of recruits. The average size of legal-size crab caught at sea decreased in 2017 and was slightly above the historical average (Figure 37).

Figure 35. Annual landings and TACs in Area 12C.

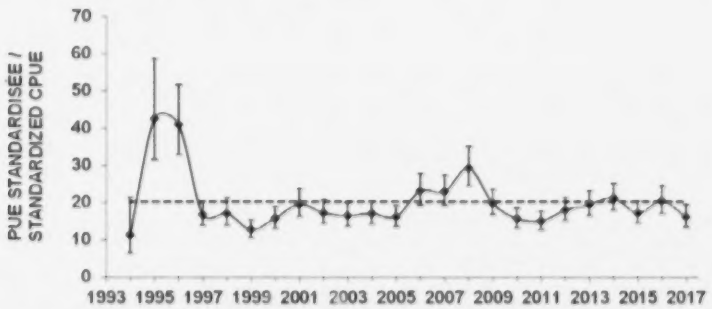

Figure 36. Standardized annual CPUE ± confidence interval in the commercial fishery in Area 12C. The dotted line shows the data series average (excluding 2017).

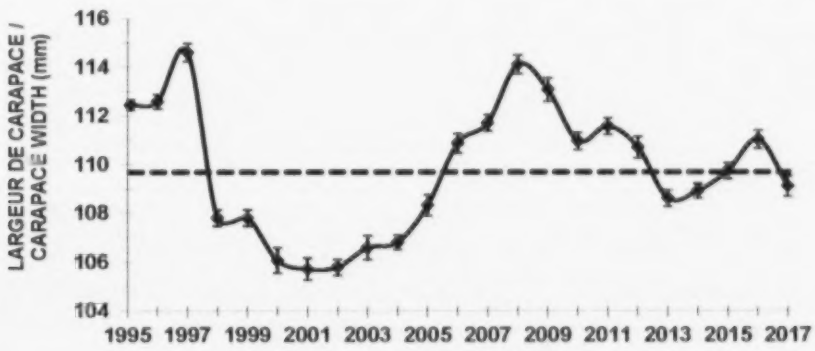

Figure 37: Carapace width ± confidence interval in the commercial fishery in Area 12C. The dotted line shows the data series average (excluding 2017).

Fishery-independent survey. The protocol for trap-based research was changed in 2014 to require the exclusive use of larger, standard conical traps of 6.5 ft. Both types of traps, former and new, were being used from 2014 to 2016, whereas the new type was used only in 2017. Since catchability with this type of trap needs to be evaluated in comparison with the former traps, only the data including this new type of trap are presented in 2017. The trap-based research survey shows that the NUE of adults ≥ 95 mm significantly decreased since 2014 (Figure 38), this decrease having begun in 2012 according to the data of the former protocol. The NUE of adolescents ≥ 78 mm decreased from 2016 to 2017 (Figure 39). These results suggest that recruitment to the fishery will be low in the short to medium term.

The combined index of commercial CPUE and NUE from the post-season survey decreased by 32% and was below average, suggesting that the biomass available to the fishery will be lower in 2018 than 2017.

Preferred snow crab habitat in Area 12C has decreased in recent years, which could have an impact on stock productivity.

In 2017, the exceptional presence of ice during the fishing season was reported, and may have caused a reduction of the CPUE for 2017.

Outlook and conclusions

Indicators of biomass available to the fishery remain low for 2018, but the post-season survey suggests increased recruitment.

1) An increase in catches of up to 10% could reduce or maintain the biomass depending on the recruitment level next year.
2) A status quo in catches would help maintain the biomass in the absence of recruitment.
3) A decrease in catches of 10% or more could help maintain or increase the biomass available to the fishery.

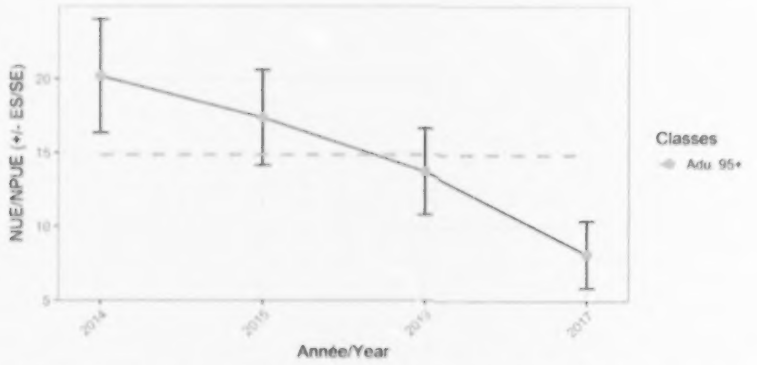

Figure 38. Annual catch rates (NUE) (± standard error) of adult crabs ≥ 95 mm from the post-season survey in Area 12C. The dotted line shows the data series average.

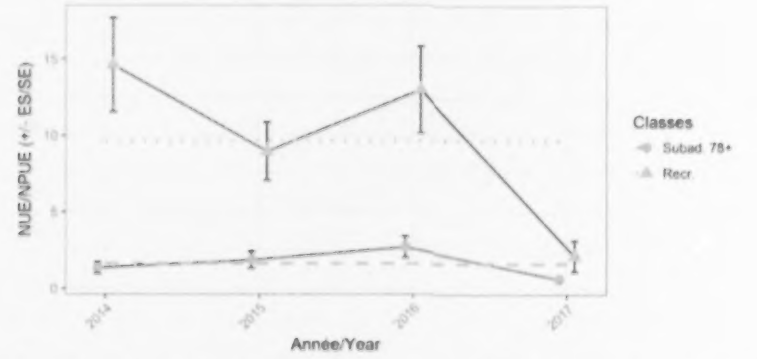

Figure 39. Annual catch rates (NUE) (± standard error) of recruits (Recruits) and adolescents (Subadults) ≥ 78 mm from the post-season survey in Area 12C.

Area 12B

Description of the fishery

Area 12B has eight regular licences. The TAC gradually increased from 246 t in 2010 to 468 t in 2014 and then decreased by 22% in 2015, by 15% in 2016 and finally by 43.7% in 2017, to a value of 175 t (Figure 40). In 2017, the fishing season opened on March 29 and closed on July 1. Landings totalled only 58 t and the TAC was not reached. The area was abandoned by several fishers, for various reasons, and fishing effort was low, which could partly explain why the TAC was not reached.

Resource status in 2017

Commercial fishery. In 2017, the standardized CPUE decreased sharply to, by far, the lowest value in the 1995–2017 series (Figure 41). Landings consisted primarily of intermediate-shell crabs. The average size of crabs caught in the commercial fishery has been decreasing for the last five years and is well below average (Figure 42).

Fishery-independent survey. The trap-based research survey conducted from 2001 to 2016 shows that the NUE of adults ≥ 95 mm, recruits and adolescents ≥ 78 mm has decreased sharply since 2013 and reached very low values in 2016. These results suggest a low biomass available to the fishery in

the short and medium term. This post-season survey was not conducted in 2017. The lack of a post-season survey in 2017 creates uncertainty with regard to future stock prospects.

A marked decrease in the preferred habitat of snow crab in Area 12B has been observed in recent years, which could have affected snow crab productivity and abundance.

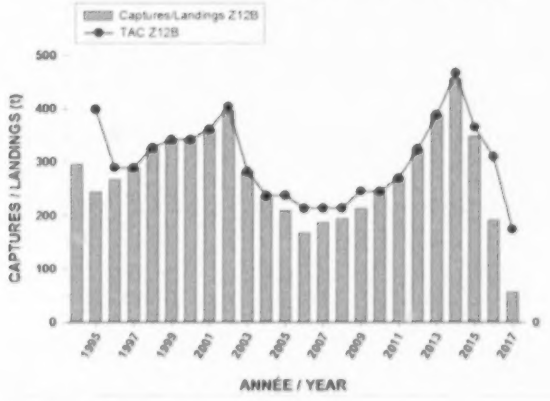

Figure 40. Annual landings and TACs in Area 12B.

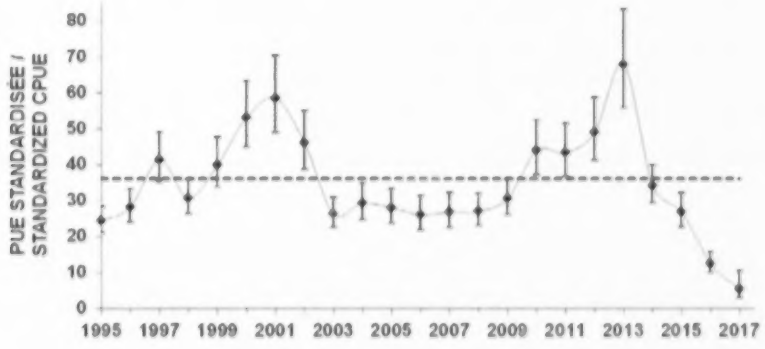

Figure 41. Standardized annual CPUE ± confidence interval in the commercial fishery in Area 12B. The dotted line shows the data series average.

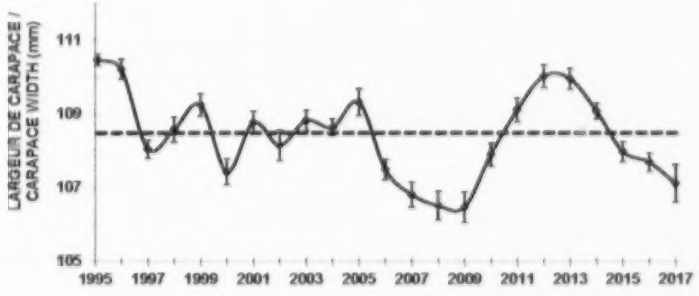

Figure 42: Carapace width ± confidence interval in the commercial fishery. The dotted line shows the data series average (excluding 2017).

Outlook and conclusions

The fact that the TAC was not reached, the sharp decline in the catch rate, and the decline in crab size suggest that stock status continues to deteriorate. Because of the limited amount of data and the high degree of uncertainty regarding the status of the biomass for this area, it is impossible to make specific recommendations.

It is recommended to set the harvest level at the lowest possible level that can allow monitoring of the area, following consultation between industry and fisheries management.

Area 12A

Description of the fishery

Area 12A has 10 regular licences. The TAC was 106 t in 2016 and was decreased by 6.6% in 2017, to a value of 99 t (Figure 43). In 2017, the fishery opened on March 28 and closed on June 5. The TAC was reached.

Resource status in 2017

Commercial fishery. The standardized CPUE went from the highest value of the series in 2013 to well below average in 2017 (Figure 44). There were few recruits (carapace conditions 1 and 2) in the landings, which consisted primarily of intermediate-shell crabs (carapace condition 3).

The average size of crabs caught in the commercial fishery, which decreased from 2013 to 2016, increased in 2017 to slightly below the historical average (Figure 45).

Fishery-independent survey. The trap-based research survey, which started in 2000, was not conducted in 2013 or 2016. The NUE of adults ≥ 95 mm decreased in 2015 and in 2017 compared to 2014, to the lowest value of the series (Figure 46). The NUE of recruits remained stable in 2015 compared to 2014, at the lowest value of the series. In 2017, it increased to a value higher than that of 2014, but is still below the historical average (Figure 47). The NUE of adolescents ≥ 78 mm decreased in 2015 and 2017 to below the historical average (Figure 47). It is important to note that the abundance of crabs in Area 12A is partially determined by overflow from adjacent areas (17 to the west and 12 to the east).

The combined index of commercial CPUE and NUE from the post-season survey is at its lowest level since 2000 and similar to 2007.

Preferred snow crab habitat in Area 12A has decreased in recent years, which could have an impact on stock productivity.

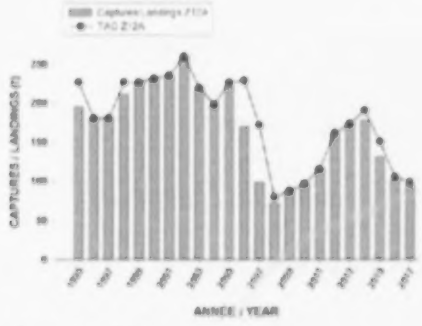

Figure 43. Annual landings and TACs in Area 12A.

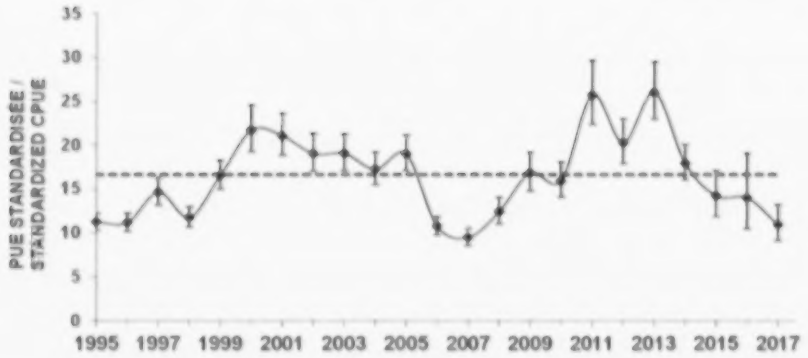

Figure 44. Standardized annual CPUE ± confidence interval in the commercial fishery in Area 12A. The dotted line shows the data series average (excluding 2017).

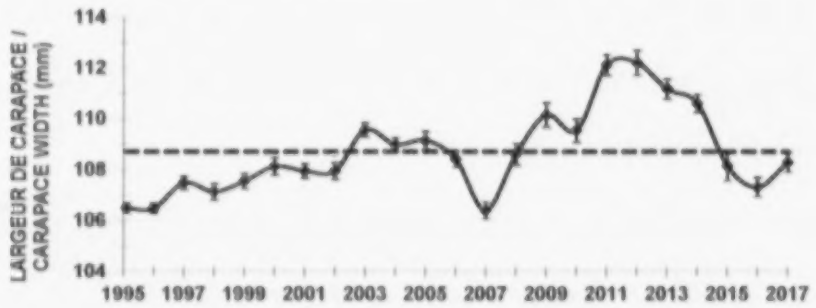

Figure 45: Carapace width ± confidence interval in the commercial fishery. The dotted line shows the data series average (excluding 2017).

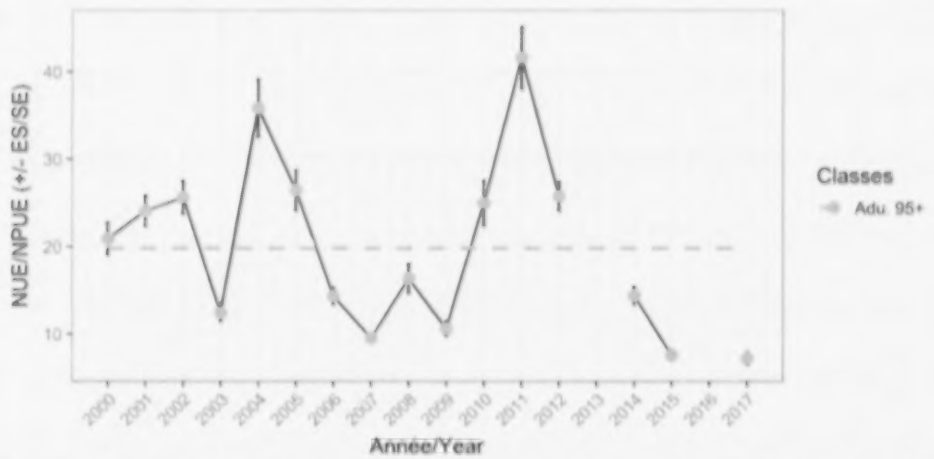

Figure 46. Annual catch rates (NUE) (± standard error) of adult crabs ≥ 95 mm from the post-season survey in Area 12A. The dotted line shows the data series average.

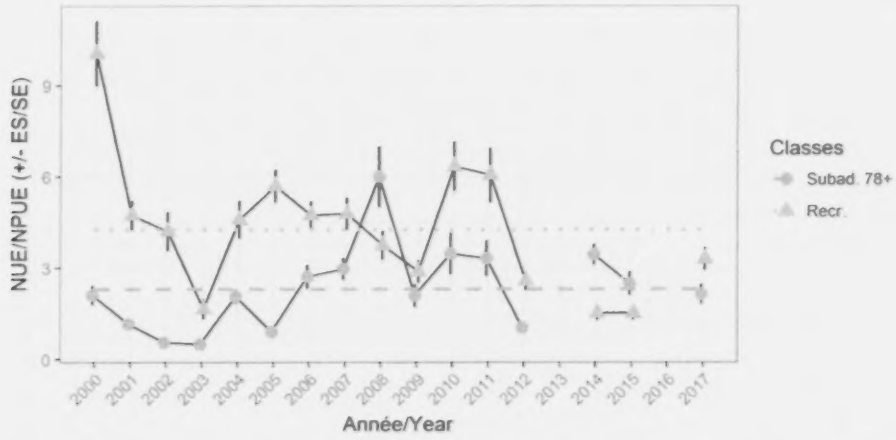

Figure 47. Annual catch rates (NUE) (± standard error) of recruits (Recruits) and adolescents (Subadults) ≥ 78 mm from the post-season survey in Area 12A.

Outlook and conclusions

Indicators of biomass available to the fishery remain low for 2018, but the post-season survey suggests increased recruitment.

1) An increase in catches of up to 10% could reduce or maintain the biomass depending on the recruitment level next year.
2) A status quo in catches would help maintain the biomass in the absence of recruitment.
3) A decrease in catches of 10% or more could help maintain or increase the biomass available to the fishery.

Sources of uncertainty

The quality of science advice depends mainly on the accuracy of the parameters obtained through sampling and the subsequent analyses. Information obtained from logbooks and purchase slips during the fishing season affects the accuracy of the parameters derived from these documents. For instance, abundance indices and fishing effort calculations obtained from logbooks may include errors that will affect the scientific advice provided. The selectivity and catchability of traps can vary depending on the type of trap used, its volume and mesh size, the amount and quality of bait used and soak time, which can vary with the fishing strategies employed and environmental conditions. The catchability of adolescent crab and recruits could also be affected by the abundance of intermediate-shell adult crab (condition 3) on the seafloor. The selective sorting of catches can also affect the quality of the data obtained.

The abundance and condition indices and the estimates of crab size obtained from the trawl and trap surveys are affected by the type of gear used and by uncertainties related to catchability variations in the different crab groups targeted. Some types of fishing gear are better suited to given seafloor areas than other types, and this factor influences the spatial coverage ultimately sampled. The biological characteristics specific to snow crab can also create sources of uncertainty that impinge on the scientific advice. For instance, the terminal moulting phase, which occurs at various sizes, affects crab condition and catchability. Natural mortality can also vary with the life cycle stage and condition of the crab.

OTHER CONSIDERATIONS

Snow crab distribution is linked to the thickness (and temperature) of the cold intermediate water layer, which is its benthic phase habitat. However, the increase in the temperature of the deep layer, observed for several years in the Gulf of St. Lawrence, accompanied by the warming of the surface layer, can reduce crab habitat area and affect its distribution. The length of early pelagic larval development stages and larvae survival are related to surface water temperatures (mainly in spring and summer) just as egg incubation time and crab growth are related to the temperature of the seafloor where they develop. It thus seems that stock distribution and productivity could be affected by the temperature in the various water layers. The effect of warming waters on crab productivity and stock distribution is a real issue. Impacts could vary significantly in different regions or areas.

SOURCES OF INFORMATION

This Science Advisory Report is from the February 13-14, 2018, meeting on the Assessment of the Estuary and northern Gulf of St. Lawrence Snow Crab stocks. Additional publications from this meeting will be posted on the Fisheries and Oceans Canada Science Advisory Schedule as they become available.

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